

Valmet

Technical Paper Series

Total Tail Control

Executive Summary

When you have total tail control throughout the machine it clearly enhances production line efficiency. Valmet offers a full range of advanced tail threading solutions for all sections of fiber, paper, board and tissue machines. As the market leader in the field, Valmet provides you with comprehensive process know-how, expertise and professional support around the world.

Mill experience with Valmet's tail threading technology has been extremely positive on fiber, paper, board and tissue machines all over the world – a fact clearly visible in their enhanced production figures. As the case studies at the end of this white paper show, Valmet's advanced tail threading solutions bring several major benefits, including:

- Significantly shorter tail threading time compared to conventional systems with ropes
- Enhanced human and mechanical safety by eliminating close calls and rope accidents
- Increased production line efficiency and reduced unexpected downtime

Vacuum conveyors – meeting tomorrow's needs

Valmet's most advanced tail threading solutions are based on effective vacuum conveyor technology. The vacuum for these conveyors is created by compressed air and a special foil nozzle. The foil and the air blow are directed at a downward angle, which is ideal for air ejection through the conveyor's rotating belt. The air blows follow the foil plates, which are shaped like aircraft wings, thus improving the suction effect between the tail and the belt.

Combining our latest tail threading technology with digital break recording and web monitoring systems provides valuable information about the tail threading process. It offers a useful tool for troubleshooting, analyzing breaks and solving tail threading problems. This provides better foresight to avoid future problems and keep the paper machine running consistently at its top efficiency.

Safe tail threading in the press section

Tail threading systems have a great impact on the time efficiency and safety of the paper making line. In the press section a well-designed layout ensures safe and successful tail threading by giving operators total control of the tail.

Valmet Tail Threading Vacuum Conveyor Press

Valmet Tail Threading Vacuum Conveyor Press is Valmet's ropeless vacuum conveyor for the press section. It features specialized technology for difficult press section applications and provides controlled tail threading. The conveyor is applicable for pickup and tail threading from a center roll, a separate press or a double-felted press. Mechanical contact with the tail is facilitated by the conveyor's optimal vacuum level. The conveyor is also of very compact construction, which makes the unit suitable for all press section geometries.

Press section tail threading can also be performed with Valmet Tail Shooter Press tail threading plates, using a safe and hands-free process.

Unique Valmet Tail Threading Vacuum Conveyor Press features include:

- Complete control of the tail
- Shorter tail threading times
- Exceptional working and mechanical safety
- Compact and simple construction
- Less need for maintenance
- Minimum amount of tail threading waste
- Suitable for center roll, separate press and double-felted press sections

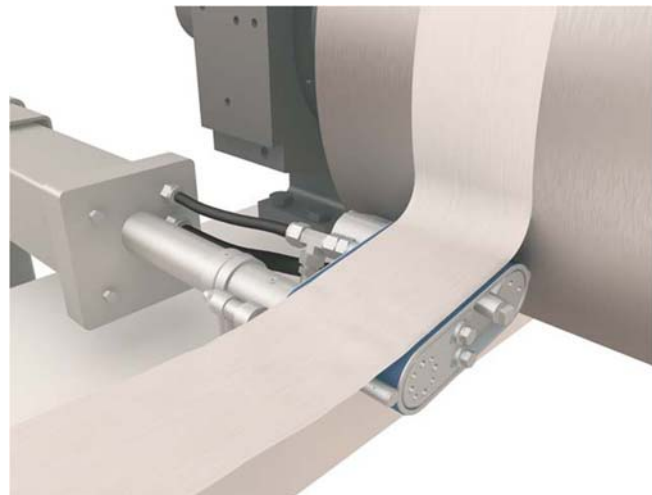


Figure 1. Valmet Tail Threading Vacuum Conveyor Press represents the latest technology on the market for press section ropeless tail threading.

Accurate tail cutting with Valmet Tail Squirt

Valmet Tail Squirt is Valmet's forming and press section tail cutting application which performs tail cutting with a pressurized water jet. This solution is also suitable for pulp drying lines. The cutting nozzle moves from the tending side to the drive side during cutting and widens the tail into a full-width web. Valmet Tail Squirt incorporates a simple water supply and step-less speed control for a smooth cutting result, easy service, and improved safety.

Focus on efficiency in the dryer section

For every grade and dryer section geometry Valmet offers a complete menu of tail threading systems and advanced tail cutting devices. The emphasis is on efficiency when threading through the dryer section,



Figure 2. SingleForce provides proven automated and ropeless tail threading in single-felted dryer groups.

and custom designed Valmet dryer threading systems provide dramatic decreases in overall downtime.

Tail threading in single-felted dryer groups with Valmet Tail Threading Single Fabric

Valmet Tail Threading Single Fabric system provides accurate and ropeless tail threading for single-felted dryer groups. It manages tail threading by means of blow boxes and vacuum rolls, Valmet Dryer Vac Rolls or Valmet Dryer Tail Vac Rolls. Air blows on the doctor beams guide the tail onto the dryer fabric. The blow boxes and vacuum rolls create a vacuum under the dryer fabric. The vacuum effectively holds the

tail on the dryer fabric, with the tail traveling around the bottom vacuum roll to the dryer cylinder above. If needed, tail threading can be interrupted and restarted using knock-off and cut-off blows at the desired point.

With Valmet Dryer Vac Rolls...

Converting single-felted dryer groups into a vacuum roll concept by grooving and drilling the rolls has many advantages. It improves runnability through high, adjustable vacuum levels and decreases web elongation due to a larger roll diameter. Tail threading and web widening are therefore easy, reliable and fast.

...or with Valmet Dryer Tail Vac Rolls

Valmet Dryer Tail Vac Roll with a vacuum zone only at the roll's front edge area is an economical way to assist ropeless tail threading in single-felted dryer groups in cases where VacRolls are not necessary from a runnability point of view.

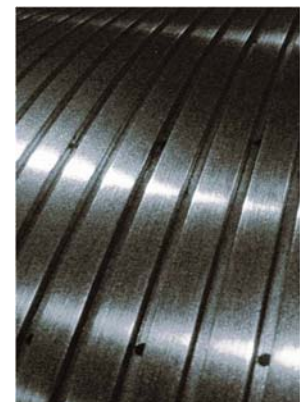


Figure 3. Grooved and drilled Valmet Dryer Vac Rolls improve runnability in single-felted dryer groups.

Tail threading in double-felted dryer groups with **DoubleForce1**

Valmet's most advanced tail threading solution for double-felted dryer groups is the **DoubleForce1** vacuum conveyor. Mechanical contact with the tail provides accurate tail control and optimal tail threading processes. **DoubleForce1** contributes to minimal tail threading waste and is not sensitive to tail width changes or process variations.

One **DoubleForce1** unit on each dryer cylinder of the double-felted group guides the tail from one cylinder to the next.

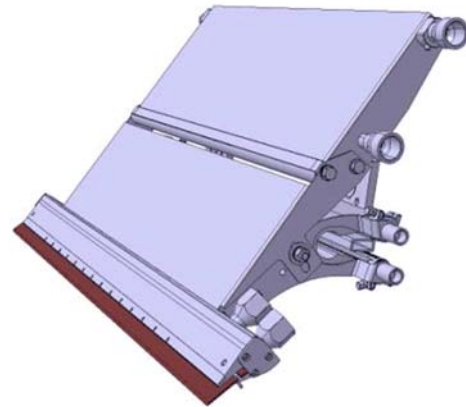


Figure 4. Valmet Tail Threading Double Fabric is used in double-fabric dryer sections of paper or board machines and requires minimal space.

Valmet Tail Threading Double Fabric air doctor for threading

Valmet Tail Threading Double Fabric tail threading units thread the sheet tail through the machine with the help of compressed air and consist of a doctor blade and a blade holder. The doctor blade separates the tail from the cylinder surface with the help of a counter-directed air blow and guide blows usher the tail to the next fabric nip. Nozzles placed in the blade holder area create a tail stabilizing zone that settles the tail, prevents cross-machine disturbances and ensures fast tail tensioning and smooth transfer. Valmet Tail Threading Double Fabric units are equipped with a loading mechanism that facilitates moving the tail threading doctor to its operating position against the dryer cylinder and releasing it back to its home position.

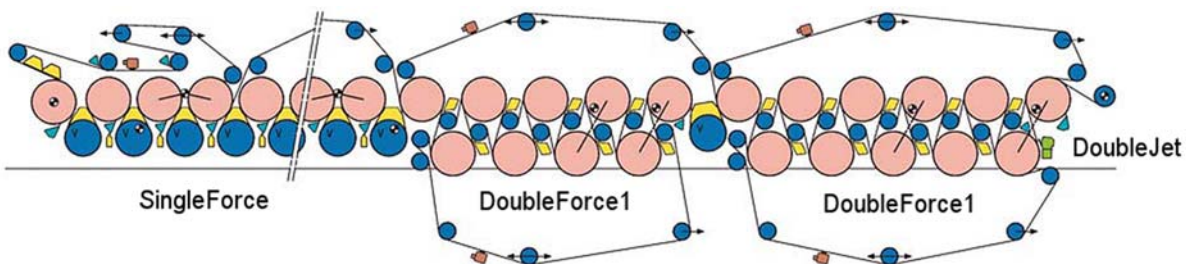


Figure 5. Valmet provides a fully ropeless tail threading process throughout the dryer section.

Tail cutting solutions

Valmet's comprehensive tail cutting solutions provide better controllability in tail threading.

The Valmet Tail Jet Cutter D water cutter has double nozzles, which cut the tail at any appropriate point of the web, and the tail width can be freely adjusted. Another major benefit is the ability to transfer the tail to a required point in the cross-machine direction away from the edge area of the web. Cutting is performed against the fabric, in an open draw or against the dryer cylinder.

In addition to Valmet Tail Jet Cutter D, a single nozzle solution for dryer section tail cutting, is also available.

These solutions provide uniform tail quality and a high level of control for the tail threading process. Tolerating sheet flutter and profile variations, the water cutters provide fast and reliable tail cutting and web spreading.

Valmet Tail Blade Cutter, a rotary blade mechanical cutting device is also available.

Fast tail threading at the sizer, coater, calender and reel

Valmet has a proven and comprehensive offering of tail threading solutions for open draws after the dryer section, at sizers, coaters, calenders and reels, that optimize the entire threading process.

A tail threading system at the surface treatment section has a great impact on the time efficiency of a paper making line. Successful tail threading is ensured by selection of proper tail threading equipment and a well-designed layout.

Proven tail threading solutions – automated processes

Valmet offers tail threading solutions for surface treatment sections to meet the specific requirements of each mill and each application. Using Valmet Tail Jet Cutter D tail cutters, the tail can be transferred toward the center of the machine. This prevents the tail from slipping back to the ropes.

Sizer, coater, calender and reel tail threading can be optimized by using correct combinations of the following components and features:

- Tail threading surveys and service contracts
- Optimized layout
- Tail cutting devices and pull-down foils
- Tail pick-up solutions
- Valmet Tail Threading Vacuum Conveyor F vacuum conveyors or Valmet Tail Shooter tail threading plates
- Crawling ropes with rope speed measurements
- Air blows
- Drives and drive controls



Figure 6. Valmet Tail Threading Vacuum Conveyor F – top of the line in tail threading.

For ropeless tail threading, Valmet offers Valmet Tail Threading Vacuum Conveyor F vacuum conveyors to provide an accurate process. Valmet Tail Threading Vacuum Conveyor F controls the tail exceptionally well and is not sensitive to any tail width changes or process variations.

Valmet Tail Threading Vacuum Conveyor F vacuum conveyors transfer the tail through open draws directly from one machine section to the next or into the rope nip. The last unit guides the desired length of the tail between the ropes to ensure a perfect tail threading process.

For accurate tail threading, trims and tails are controlled by pull-down foils. They are located on the doctor of the last drying cylinder before the reel. These foils also hold and guide the tail from the reel drum to the pulper, and prevent the tail from wrapping around the reel spool too early in different tail widening situations.

To achieve a reliable tail threading process at the reel, it is important to transfer the tail straight and fast into the nip between the reel drum and the reel spool, and onwards to the pulper. For this purpose the reel drum can be equipped with a suction zone located on the threading line.

Tail threading processes face many challenges including producing webs of varying widths, low quality edge areas and the need to prevent bottom waste at the reel. In these cases it is beneficial to feed the tail in at different positions in the cross-machine direction. Tail cutting and threading can be performed even in the middle of the machine to provide the perfect process.

When the tail is cut to its threading width from the middle of the web, there is no risk of web width changes or worn-out edges affecting the process. Furthermore, threading the tail onto the reel in the middle of the machine makes it possible to avoid the "carrot effect".

For all paper, board and tissue grades, Valmet also offers a comprehensive range of different tail pick-up

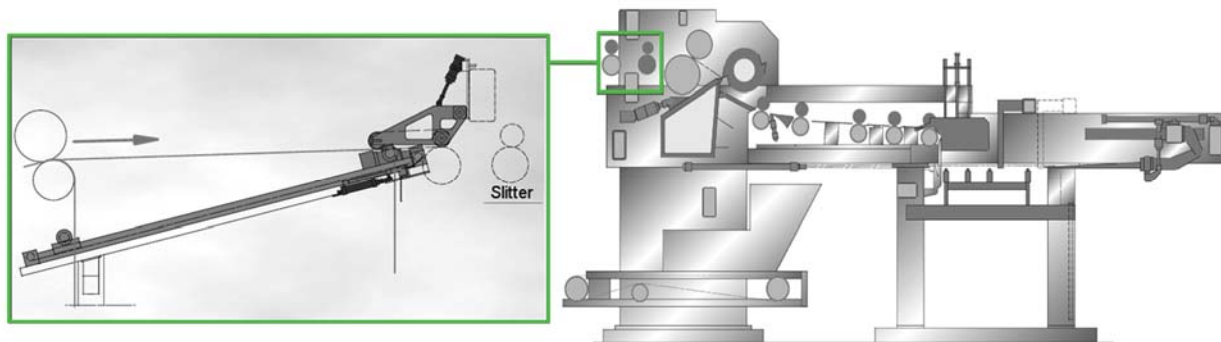


Figure 7. TailShooter HW ensures a safe and reliable transfer of the tail from the dryer section's pull stack to the cutter layboy automatic tail threading device.

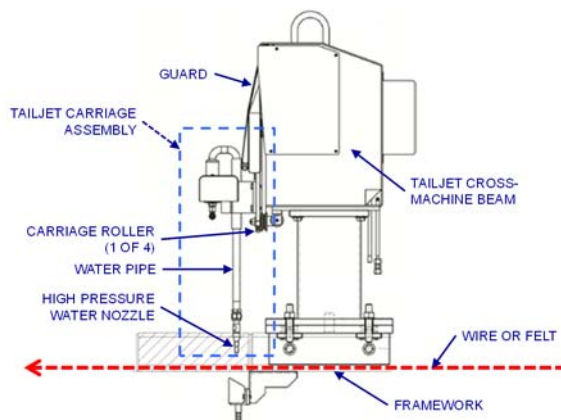


Figure 8. Valmet Tail Jet Cutter (shown in sideview) uses a waterjet cutter to cut the tail and widen the sheet.

solutions to ensure reliable and easy tail threading. These pick-up devices are integrated into vacuum conveyors and are based either on air or mechanical cutting methods.

Grade-specific threading solutions

Regardless of the grade being produced, from lightweight to the heaviest grades made, the appropriate combination of Valmet tail threading components will reduce or eliminate manual labor, increasing safety and efficiency.

For pulp machines

TailShooterHW automatically transfers the tail from

the dryer section's pull stack to the cutter layboy. The tail is carried by a transfer roll attached to a linear unit. The tail is cut by a pneumatically operated blow unit. After cutting, the tail is transferred by a tail threading belt to the cutter layboy draw-press.

Valmet Tail Jet Cutter is designed to waterjet cut the tail when threading the cutter layboy. It works with all heavy grades as well as pulp grades. Valmet Tail Jet Cutter cuts the tail and spreads the sheet after threading.

For board grades

Valmet Tail Blade Cutter is a conventional disc cutter, which uses a pneumatic motor-operated circular toothed blade. Exhaust air from the air motor is directed into a special nozzle pipe and blown through the nozzle holes along a flat support plate in an even jet flow. The air jet causes a vacuum which sucks the paper toward the surface of the support plate. After successfully threading the tail downstream, Valmet Tail Blade Cutter moves from TS to DS widening the sheet.

For tissue production

Valmet Tail Threading System Tissue is a hands-free and fully automated tail threading system which uses air as the carrying medium to guide the tail from the Yankee doctor to the reel. This system will maximize your efficiency and has the ability to handle the tail within a wide range of speed and basis weight variations.

Excellent economic returns with Valmet Tail Threading System Tissue

The Valmet Tail Threading System Tissue system offers excellent economic returns, with payback times of six months or less possible. After installation of a Valmet Tail Threading System Tissue on a 6.5 m (255") wide machine running at 1760 mpm (5800 fpm), the efficiency improvements resulted in a payback time for the whole project of less than 5 months. These big savings were due to reduction of lost time as a result of improved threading.

With the **Advantage Tail TurnUp** system, tissue machine operators always know they can rely on this system when sheet breaks occur. The **Advantage Tail TurnUp** system offers: flexible connection to enable testing and maintenance during production, a self cleaning glue spray gun, and an operator friendly control unit with integrated glue pump.

Installing **Advantage VacBox** on your reel drum increases dry end efficiency. This special vacuum box technology holds the tail firmly to the reel drum, improving the threading, turn-up operation and overall machine efficiency. The special seal arrangement prevents paper from being drawn into the box and catching fire or causing other damage.

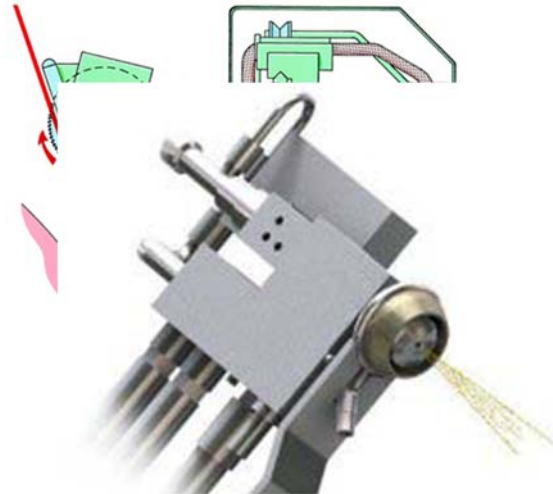


Figure 1: Valmet Tail Blade Cutter. This is a conventional disc cutter which is applied for cutting on a new spool / core shaft or on a parent roll with wide tail.

Tail threading with ropes

Valmet Tail Threading Rope systems offer a wide range of solutions for reliable and efficient rope-based tail threading. **RopeSheaves** include eight types of sheaves of various compositions to suit your requirements, with grease lubricated roller bearings and central lubrication if needed. With pneumatically operated **RopeStretchers** connected to sheet break automation, you can achieve greater rope tension during the tail threading process, as well as long stretching length. **RopeDrive** includes incoming and outgoing rope sheaves, with couplings and drive motors. The pneumatically operated **RopeOffTrack** moves the rope sheaves outside the machine during production.

Threading services

Valmet's Tail Threading Survey audits the performance of the current tail threading process. The four stages of this survey consist of a kick-off meeting, an analysis during a machine shutdown, a report containing the detailed analysis, and an action plan based on Valmet expert's recommendations.

A Tail Threading Analysis and Adjustment is for more immediate results. When it is performed, all necessary and possible adjustments are made while the Valmet expert is on-machine. The analysis includes a written report and recorded video showing the analysis results and changes made in the process. Typical potential problems that can be found and rectified include: misalignment of components, plugged air jets, insufficient air flow, improper procedures and missing or damaged components.

Case studies of threading systems in application

The following brief reviews of Valmet tail threading system installations over the last decade will prove how safety and efficiency can be improved with the carefully planned implementation of select threading components.



Figure 12. A Tail Threading Survey is the best way to evaluate your threading system and plan a path forward.

Fine paper mill improves production

A 4.3m wide Valmet paper machine was installed in 1996 to make high-quality fine papers with a special focus on multicoated graphical paper products in sheets. The machine line was highly automated and included an off-machine coater, two supercalenders, a rereeler, two winders and a roll wrapping line. A few years later the mill decided to increase efficiency by implementing a speed-up project.

The first phase of the project was a paper machine analysis performed by Valmet in 2000. The 500-page analysis report identified what changes and modifications were needed in order to increase the speed to 1200 m/min. It also identified all immediate reconditioning needs. All sections of the machine line were investigated, and studies included mechanical condition, dynamic behavior, runnability and air systems, as well as concept and capacity. The report included 140 recommendations, classified into 1) vital remedial tasks, 2)

quality and runnability improvements and 3) optimization actions.

In the second phase, 30 Valmet experts and 200 local workers upgraded the machine line. Work was performed from the headbox through the finishing section. One of the improvements was the installation of a state-of-the-art threading system from the press section to the reel. This included two Valmet Tail Shooter Press units, a Valmet Tail Threading Roll unit and a Valmet Tail Threading Vacuum Conveyor F tail threading system in the size press, calender and reel. Also included was a ropeless tail threading system in the dryer section.

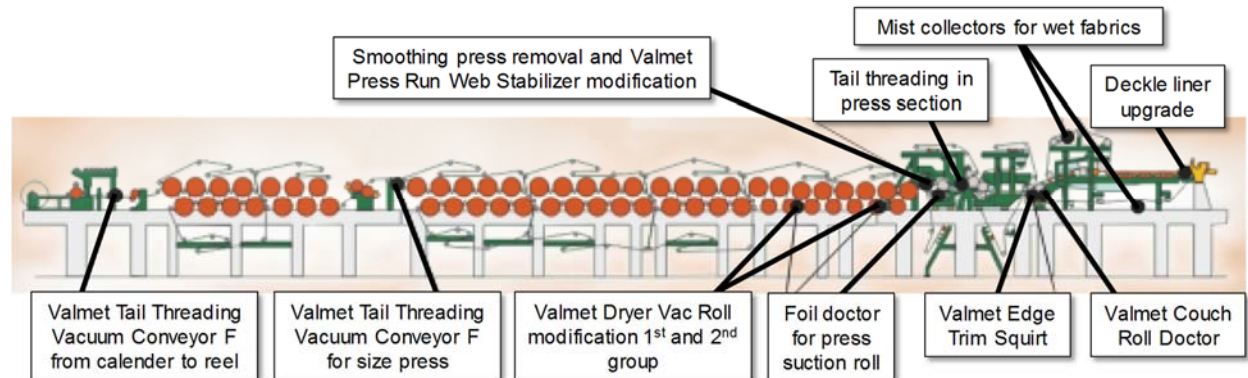


Figure 13. The PM1 fine paper speed-up project involved modifications to the entire production line.

Total machine time efficiency increased 5%

Only a few months after startup efficiency had improved from 87% to 92%, with corresponding reductions in web breaks and production improvement from 356 tpd to 400 tpd. The improved tail threading system played an important part in this successful startup. According to the Production Director, "To stay on top, you have to keep an open mind and continuously improve operations, with a focus on the customer's demands."

Board mill reduces break time

A board mill was unhappy with the tail threading from the press section to the reel and wanted to improve the BM5 overall efficiency by cutting tail threading times. After consulting with Valmet, the mill decided to carry out a joint rope-assisted tail threading system improvement project starting with a Tail Threading Survey. Additional objectives included reducing unscheduled shutdowns, related energy savings, prolonging rope life, and improving the systematic use and maintenance of the rope-assisted tail threading equipment.

The resulting Tail Threading Survey involved a Valmet specialist working with the mill for both shutdown and during-production investigations. All critical threading process elements were reviewed.

Salient observations were recorded in a report that included recommendations for fixing any problems discovered, further development of the rope-assisted tail threading system, and improving operational reliability. Many of the problems discovered could be repaired immediately in the course of the shutdown. A follow-up day was organized a few months later to review the status of the agreed action plan, update the plan where needed, and make more detailed target tracking arrangements.

Break times reduced by 60%

The following results were noted by the mill as a result of the threading improvement project:

- Break time attributable to rope-assisted tail threading has declined by 60 %.
- Tail threading times are shorter.
- Operations are now more systematic with timely rope replacement at scheduled shutdowns.
- Required rope tensions have decreased, slippage has been eliminated.
- Updated rope diagrams make the installation of ropes easier.

According to the BM5 Machine Superintendent, "Fixing the rope-assisted tail threading system's trouble spots helped to reduce malfunction rates. The improvement of systematic preventive maintenance can be seen in fewer rope-assisted tail threading disturbances and better time efficiency."

Minimizing break times at an LWC mill

Tail threading improvement investments are generally very cost-effective and related payback periods tend to be short. The crew of an LWC mill's PM2 can attest to this. They upgraded the twin-fabric area of the machine's dryer section to the Valmet Tail Threading Double Fabric tail threading system in 2008. PM2 produces 185,000 metric tons of coated (LWC) magazine paper per year.

The investment was motivated by tail threading challenges experienced in the twin-fabric dryer area of PM2. "The prior rope-based tail threading solution required a lot of maintenance and upkeep, and breaking ropes used to cause unscheduled shutdowns," according to the PM2 Production Manager. Tail threading would become difficult after longer breaks because the smoothness of tail threading depended on changes in the sheet moisture content. Extended sheet breaks consequently impaired production efficiency.

The Production Manager continues, "Valmet offered us a good comprehensive package and a reliable tail threading solution. Compared to the competition, the separate doctor blade and blade holder design of Valmet Tail Threading Double Fabric is a workable and, above all, a cost-effective solution. The post-installation start-up was easy. In fact, Valmet Tail Threading Double Fabric works invariably well at start-ups and in exceptional situations where rope-assisted tail threading is difficult. It allows greater moisture variations and is also insensitive to speed changes."

Practice has also shown that Valmet Tail Threading Double Fabric represents a maintenance-free solution. "We honestly haven't serviced the equipment at all over the past year and tail threading still works perfectly. No need to replace the doctor blades is in sight either," says the PM.

Efficient results, break times cut by 35 %

The goals set for the investment were achieved quickly, and the mill is pleased with the outcome. According to the Machine Supervisor, "Valmet Tail Threading Double Fabric is a workable solution." Tail threading is now more efficient and safer. Average tail threading times have been cut by one-third, and the amount of tail threading broke has diminished as well. Extended breaks no longer present a problem. The Supervisor also



Figure 14. Valmet Tail Threading Double Fabric tail threading units thread the tail through the PM2 LWC line by means of compressed air.

notes that tail threading is now less frustrating for the crew, "The tail now runs through the machine with the press of a button and you no longer need to look out for the ropes." According to the Production Manager, "We now have a safe and efficient tail threading system."

Sack paper mill improves safety and productivity

A kraft paper mill desired to increase safety and simultaneously decrease tail threading time on their PM9 sack paper machine. They approached Valmet to accomplish these targets. During the project 15 **DoubleForce1** units were installed in the drying section and 3 Valmet Tail Threading Vacuum Conveyor F units with special blow-plates were installed before and after the pope.

Despite the amount of new technology installed, the mill troubleshooter had no concerns about maintenance or threading problems. After visiting other mills using the same technology, he was convinced that these solutions are maintenance free.

Ropeless tail threading on PM9 has been a complete success. In addition to the increased production and direct savings in time, the mill no longer suffers from the imbalance in the machine that almost always used to arise when it stood idle too long. Thanks to the new technology the machine can be started up so quickly following a stoppage that this particular problem is a thing of the past.

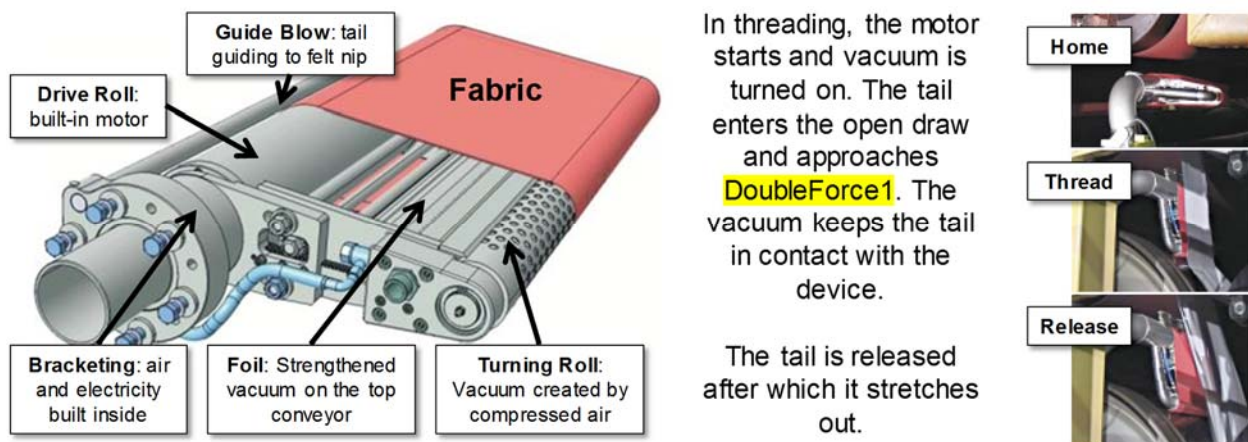


Figure 15. DoubleForce1 (shown above) and Valmet Tail Threading Vacuum Conveyor F improved operator safety and reduced threading time on the PM9 sack paper line. Operation is simple as the units move automatically from home, to thread and release positions.

Threading time reduced 30%

Both productivity and safety at the mill have been significantly improved. According to mill management the ropeless technology has improved operational safety due to the elimination of rope accidents in the dryer section. It has also reduced the average time needed for threading by about 30 percent. "Thanks to the fast tail threading the production of PM 9 has increased by about 50 tons per day," states the Mill Manager. He concludes, "Our experience with Valmet's tail threading concept is very good. Furthermore, improved machine usability pays this kind of investment back in just a few months."

Enhanced efficiency – more from less

Using the right scope of tail threading solutions provides potential for increasing a machine line's production efficiency, resulting in increased production. At the same time substantial savings in raw materials, personnel and maintenance costs can be gained.

Shorter threading time and reduced downtime lead to increased machine efficiency. When combined with the improvements in safety, especially when going to a ropeless threading system, a mill's gains are significant and worth serious consideration.

This white paper combines technical information obtained from Valmet personnel and published Valmet articles and papers.

Valmet provides competitive technologies and services to the pulp, energy and paper industries. Valmet's pulp, paper and power professionals specialize in processes, machinery, equipment, services, paper machine clothing and filter fabrics. Our offering and experience cover the entire process life cycle including new production lines, rebuilds and services.

We are committed to moving our customers' performance forward.



Figure 16. Safety is the most important factor when choosing to automate a threading system. Smart upgrade planning values safety improvements side-by-side with reducing unexpected downtime and decreasing threading time as the key benefits of a successful threading system rebuild.